

Metal/Silicate Partitioning at High Pressures and Temperatures

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The behavior of siderophile elements during metal–silicate segregation, and their resulting distributions provide insight into core formation processes. Determination of partition coefficients allows the calculation of element distributions that can be compared to established values of element abundances in the silicate (mantle) and metallic (core) portions of the Earth. Moderately siderophile elements, including W, are particularly useful in constraining core formation conditions because they are sensitive to variations in T, P, oxygen fugacity ($f\text{O}_2$), and silicate composition.

To constrain the effect of pressure on W metal/silicate partitioning, we performed experiments at high pressures and temperatures using a multi anvil press (MAP) at NASA Johnson Space Center and laser-heated diamond anvil cells (LHDAC) at the University of Maryland. Starting materials consisted of natural peridotite mixed with Fe and W metals. Pressure conditions in the MAP experiments ranged from 10 to 16 GPa at 2400 K. Pressures in the LHDAC experiments ranged from 26 to 58 GPa, and peak temperatures ranged up to 5000 K. LHDAC experimental run products were sectioned by focused ion beam (FIB) at NASA JSC. Run products were analyzed by electron microprobe using wavelength dispersive spectroscopy.

Liquid metal/liquid silicate partition coefficients for W were calculated from element abundances determined by microprobe analyses, and corrected to a common $f\text{O}_2$ condition of IW-2 assuming +4 valence for W. Within analytical uncertainties, W partitioning shows a flat trend with increasing pressure from 10 to 16 GPa. At higher pressures, W becomes more siderophile, with an increase in partition coefficient of approximately 0.5 log units.